WESTSIDE INTERNATIONAL

Compact maintenance free drying for commercial and industrial enclosures and cabinets for OEMS and end users

White Paper

Contents

Abstract

Humidity damage and condensation in enclosures can be hard to control. This white paper introduces Rosahl, a compact electric enclosure dehumidifier that removes excess moisture from the air without involving liquid water. Suitable for enclosures from 500 ml up to 4m³, the entire process is maintenance free.

The factor unique to Rosahl membranes are that it is solid state. Having no moving parts means they are silent, vibration free, and have a long operating life. Moreover, they have a low energy footprint and fit into almost any size of enclosure.

The paper considers the challenges of dehumidifying enclosures, compares alternative solutions and how to apply Rosahl membranes. Moreover, it provides users with practical information on how to select and install the products to get the best performance.

For the OEM using Rosahl enhances their reputation by reducing warranty claims, and end users also enjoy low running costs and reliable and consistent performance from their equipment. Developed by Mitsubishi Electric in 2010, the technology is ideal for protecting remote and hard to service equipment from moisture damage.

Introduction

Controlling moisture in cabinets and enclosures

Excess moisture in electrical cabinets can lead to expensive equipment failures and loss of production. This can result in significant financial consequences like manufacturing bottlenecks, lost production and sales, scrap materials and wasted energy. In storage and display cabinets, it can damage, degrade, or destroy the contents.

Materials and processes have different tolerances to moisture, so it is important to manage the conditions in each case. An enclosure dehumidifier controls the humidity to a level where it does not affect the contents or performance. Membrane dehumidifiers can also form part of an integrated micro climate control system.

Water vapour is a gas and mixes seamlessly with air, Humidity is a measure of the water vapour held in the air. The volume of water suspended in the air depends on the temperature: warm air holds more than cool air. For example, one cubic metre (1m³) of air at 20° C will hold about 17g of water as vapour, whereas at 40° C it will hold up to 51g or three times as much.

This means that as the temperature of the enclosure falls the air will hold less moisture. Continued cooling increases its relative humidity until the water vapour density reaches its saturation point (100%). It is here that the water vapour condenses into liquid water, usually on a cool surface. This may happen at night or may result from a refrigeration process like chilled water pipes. The temperature at which this occurs is the dew point temperature.

Introducing Rosahl micro dehumidifiers as a potential solution

Waterless and maintenance free enclosure drying

Rosahl is a unique electric micro-dehumidifier for enclosures. It uses a solid-state polymer electrolyte (SPE) membrane mounted in a flat panel, and models are available for enclosures from 500 ml up to 4m³. The entire drying process is waterless.

Its development was in response to demands for a compact enclosure drying solution to protect sensitive equipment from moisture damage. It has since found its way into protecting laser and electro-optical processing systems, material storage and display cabinets, capital equipment, electrical control panels and cabinets, CCTV cameras and more.

What are micro dehumidifiers?

Rosahl is a solid-state micro dehumidifier offering an innovative but well proven alternative to conventional dehumidifying for enclosures from 500ml up to 4m³. It employs an electrolytic membrane to remove moisture at a molecular level when connected to a 3 Volt DC supply.

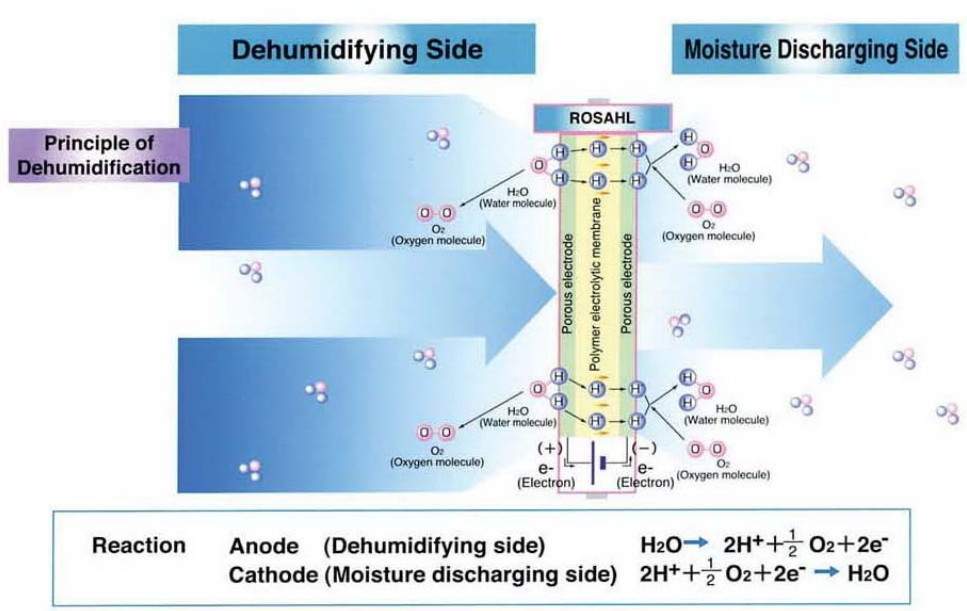
Using electrolysis means the process is waterless and maintenance free. Moreover, its compact size gives Rosahl membranes another significant advantage over alternatives. For example, the membranes for drying enclosures up to 5 litres are the size of an AA battery, and for up to 500 litres, measure 89 x 84 x 16mm.

Rosahl ionic membranes are appropriate for most enclosure drying applications. This includes material and artefact storage, display panels, electronic and optical processing systems and lasers, material storage small enough for CCTV cameras and remote monitoring stations. They are also suitable for indoor and outdoor applications.

How micro dehumidifiers work

Rosahl membrane micro-dehumidifiers work using electrolysis. Electrolysis removes moisture from enclosures at a molecular level giving it some unique benefits. Sometimes called an ionic pump or ionic membrane dehumidifier, the dehumidifying process does not produce liquid water, and remains maintenance free throughout its operating life.

The membranes comprise of a proton-conductive solid polymer electrolyte (SPE) membrane with gas porous electrodes. On applying 3 Volts D.C. to the terminals, the anode (dehumidifying) side attracts moisture where it separates into hydrogen ions (H+) and oxygen. The hydrogen ions (not gas) migrate through the membrane and are released outside the enclosure where they react with oxygen in the air to form water vapour. By reversing the membrane, the SPE can also work as a humidifier.



Advantages of Micro Dehumidifiers for Cabinets and Enclosures

Rosahl are fit-and-forget dehumidifiers for long-term humidity control of industrial and commercial enclosures and cabinets. They are also suitable for equipment installed in remote locations, or where a conventional dehumidifier would be difficult to maintain or service. They operate over a temperature range of -10 to +50°C and up to 95% relative humidity.

With tens of thousands of units sold each year around the world, Rosahl offers many advantages over conventional drying solutions.

Compact size

The membranes are available in several formats and suitable for enclosures of almost any size. All membranes in the range operate at 3V (3.0-3.3V) DC, making them easy to install.

Improved reliability and longevity of solid-state dehumidifiers

Rosahl dehumidifiers remove moisture by electrolysis. They have no moving parts and are silent and vibration free in operation, so there is nothing to wear out. This gives them a half-life of 5-6-years when operating 24/7 or longer by oversizing them for a given volume.

Reduced maintenance costs

Maintenance is often a hidden factor when purchasing equipment. Because the process does not involve liquid water, it needs no drainage or cleaning needed so there are no maintenance costs. Moreover, there is not servicing downtime.

Lower lifetime operating costs

Besides no maintenance costs, Rosahl membranes also have a small energy footprint. As the enclosure humidity falls, the membranes draw less current until they each a steady state of a few Watts. They can even work from a solar array/battery system.

Alternative cabinet dehumidifiers

Method	**Rosahl**	**Peltier**	**Space heater**	**Desiccant**
Power usage	Very low	Low	Very high	Low-recharge cost only
Initial cost	High	Medium	Medium	Medium
Size	Very small	Compact	Medium	Small
Cost of ownership	Very low	Medium	Medium	Medium
Running cost	Very low	Medium	Very high	Low
Minimum humidity	>10%	~40%	n/a	Typically, 20%
Low temperature	-20C	+10C	More power	Performance reduction
Maintenance	None	Drainage	None	Replace/recharge
Noise	None	Fan noise	None	None

Selecting a Rosahl micro dehumidifier for your needs

Membrane dehumidifiers are compact low power devices for the long-term protection of equipment in cabinets against humidity. Selection assumes that the cabinets remain closed for most of the time as the initial drying times may take some hours.

Several factors determine Rosahl's dehumidifying capacity (cabinet internal humidity):

I. The volume of air in the cabinet

It is important to consider the volume of air inside the enclosure rather than the external dimension. For example, if the enclosure is 50% full by volume of non-porous material, then the volume that needs dehumidifying is smaller. When designing a new product, consider minimising the dehumidified section to the smallest practical volume.

II. The ambient humidity

Ambient humidity levels are always changing and for lower ambient conditions, smaller dehumidifiers may be suitable. The selection table provides a guide for ambient relative humidity levels of 95%.

III. The target humidity

Selection table indicates dehumidifiers for 30%, 50% and the 75% target humidity, assuming a 90% RH ambient. It is always advisable to check performance by conducting actual tests.

IV. Temperature

For applications subject to fast or wide temperature changes, humidity-controlled dehumidifiers may not respond in time to avoid condensation. In these cases, we recommend operating the dehumidifier 24/7 or using a time controller.

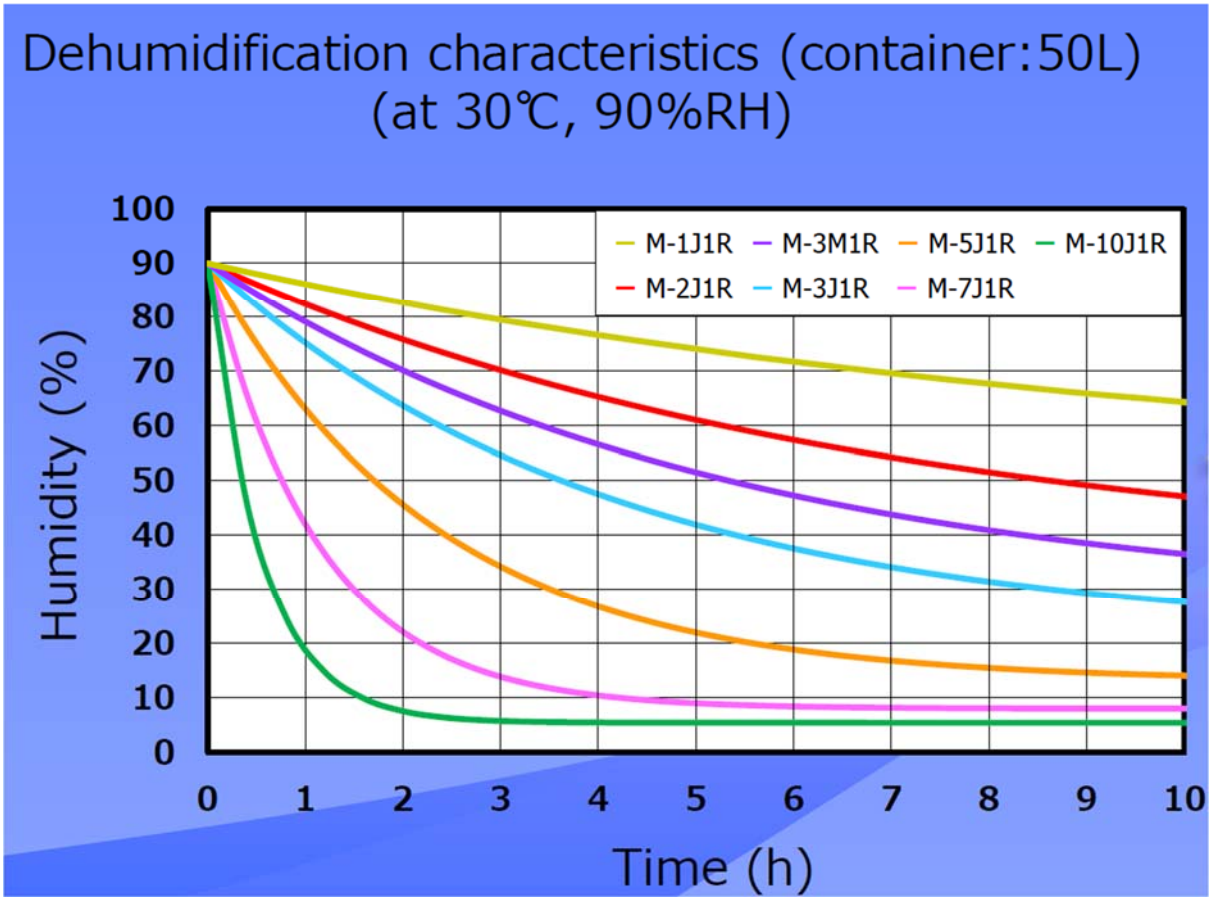
V. Initial drying time

Depending on the selection, the initial drying time can take many hours. Oversizing the membrane for a given volume reduces the initial drying time. Simulated drying curves based on specified conditions are available on request. Where the contents of the enclosure absorb or adsorb moisture a longer initial drying time will occur until reaching a steady state condition.

VI. Other factors

Continuous operation at high temperatures will reduce the effective operating life of the membrane. Contact us for details.

This table indicates the dehumidifying performance for membranes installed in a 50-litre enclosure.



Selection table

From the table below, select a suitable model for the volume and target humidity. For example, if your ambient humidity is 90% with a cabinet volume of 0.5m³ and your target humidity is 50% then select the M-5J1R or MDL-5 membrane. This table allows for an ambient humidity of up to 90% and assumes a minimal leakage area. Where in doubt, use the next larger size.

90% ambient humidity	Target humidity 30% RH	Target humidity 50% RH	Target humidity 75% RH
Membrane	**Membrane capacity**		
PD4, PD5	0.25 l	0.5 l	1 l
PD2, PD3, RD3, RD4	0.5 l	1 l	2 l
RS1, RS2	1.25 l	2.5 l	5 l
M-1J1R	30 l	65 l	125 l
M-2J1R	60 l	125 l	250 l
M-3M1R	90 l	180 l	350 l
M-3J1R & MDL-3	0.125 m^3	0.250 m^3	0.5 m^3
M-5J1R & MDL-5	0.25 m^3	0.5 m^3	1 m^3
M-7J1R & MDL-7	0.5 m^3	1 m^3	2 m^3
M-10J1R	1 m^3	2 m^3	4 m^3
Note: 1m^3 - 1000 litres			

Rosahl models

PD Series M12 screw-in dehumidifiers for enclosures up to 2 litres. External installation, internal connection. Optional locking rings available Dimensions Ø 17 x 11mm.	
RD Series flat membranes for enclosures up to 2 litres. One version for external mounting and connection and one for internal. Dimensions 24 x 30 x 5.5mm.	
RS Series flat membrane for enclosures up to 5 litres. External mounting with internal connections. Dimensions 21 x 28 x 13.5mm.	
MDL flat membrane for enclosures from 0.5 to 2m^3. Three models for internal or external mounting and connection.	
M Series for enclosures from 250 litre to 4m^3 Six models for internal mounting and connection. Membranes mounted in pre-drilled stainless-steel frames with a preformed gasket. External mounting on request.	
Images not to scale.	

How much moisture will Rosahl remove?

The manufacturer publishes dehumidifying capacity at 30° C and 60% RH as an indication of performance. Precise moisture removal depends on the temperature and absolute humidity (g/m^3) in the enclosure.

The capacity of a largest membrane (M-10J1R) is 29g/day at 30° C and 60% RH. Under these conditions, the absolute enclosure humidity is 18.21g/m3. From this, you can calculate the membrane capacity under different conditions. For example:

At 30°C and 40% RH = 20.2 grams/day membrane capacity
At 30°C and 90% RH = 44.2 grams/day membrane capacity
At 20°C and 60% RH = 16.6 grams/day membrane capacity
At 40°C and 60% RH = 48.8 grams/day membrane capacity

Membrane technical specifications

Model	Nominal Volume Litres	Dehumidifying capacity grams/day	Average Power W*	Dimensions (h w d) mm	Weight grams
PD4/PD5	1l	0.042	0.06	Øm17 x 11mm	0.9
PD2/PD3	2l	0.084	0.08	Øm17 x 11mm	1.8
RD3/RD4	2l	0.084	0.08	Øm17 x 11mm	1.8
RS1/RS2	5l	0.21	0.22	21 x 28 x 13.5	3.4
M-1J1R	125l	1	1	52.5 x 50 x 16.5	70
M-2J1R	250l	2	1.5	67.5 x 50 x 16.5	85
M-3M1R	350l	2.9	2	65 x 62 x 16.5	90
M-3J1R	500l	4	2	74 x 58 x 16.5	95
M-5J1R	1m³	8	3	89 x 84 x 16.5	150
M-7J1R	2m³	16	6	117 x 105 x 17.5	340
M-10J1R	4m³	29	12	162.5 x 155 x 17.5	580
Note:1m³ = 1000 litres					

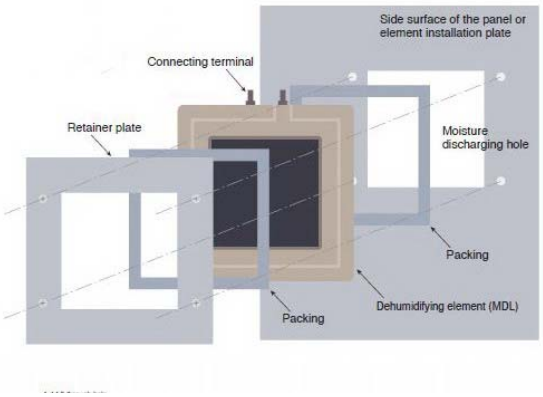
* Typical annual average power consumption in Japan

All model 3V to 3.3V DC and temperature range -10 to 50C

Storage temperature range -40C to +80C

Installation and precautions

The membranes need a hole in the enclosure side through which they expel the unwanted vapour/gas. As water vapour is less dense than air, the preferred location is for vertical mounting midway up one of the side panels. The membranes will operate in any plane although the maker recommends against horizontal mounting due to the risk accumulations on the membranes' operating surfaces.



Circulation fan

The membranes do not need forced air circulation within the enclosure. Yet, it may be helpful in larger enclosures or to avoid areas of poor circulation. Moreover, using a circulation fan will reduce initial drying times.

Rain covers for direct installation.

For outdoor installations, protection against the elements is necessary to prevent water and insects from blocking the moisture discharging area. Water will not damage the membranes but will affect their performance until they dry. Alternatively, use a moisture-permeable sheet to prevent it from getting wet.

Control options.

The membranes use a 3V to 3.3V DC supply and simple on/off control. PID type control is not possible. They can operate 24/7 or controlled by a time switch or hygrostat. Frequent switching of the membrane does not affect the operating life.

Precautions

- It is important to ensure the correct polarity when connecting the membranes. Reversing the polarity will quickly cause permanent damage to the membrane's electrodes.

- Do not to use silicone-based sealing materials to improve airtightness of a container. When curing, their outgassing will adhere to the membrane surface and quickly reduce its performance. Modified silicone caulks are acceptable.

- Do not use Rosahl membranes with vapor phase corrosion inhibitor, insect repellents or volatile organic compounds (VOCs) as they will damage the membrane.

- Please read the Installation Manual

Conclusion

In conclusion, Rosahl micro dehumidifiers offer a compelling solution for effectively controlling moisture and humidity in cabinets and enclosures. This white paper has highlighted the numerous advantages of using Rosahl membranes, including their compact size, solid-state technology, low energy consumption, and maintenance-free operation.

By using solid-state polymer electrolyte (SPE) membranes, Rosahl dehumidifiers offer waterless and maintenance-free option for drying enclosures. The absence of moving parts ensures silent and vibration-free operation, enhancing reliability and longevity.

Compared to alternative dehumidifying methods, Rosahl micro dehumidifiers demonstrate superior performance and cost-effectiveness. Their small energy footprint, reduced maintenance costs, and fit-and-forget nature make them a desirable choice for long-term humidity control.

The white paper has also provided practical guidance on selecting the appropriate Rosahl model based on factors such as enclosure volume, ambient humidity, target humidity, temperature, and initial drying time. The selection table offers a comprehensive overview of the dehumidifying capacity for different models, aiding in the decision-making process.

By incorporating Rosahl micro dehumidifiers into cabinets and enclosures, OEMs can enhance their reputation by reducing warranty claims, while end users can benefit from lower running costs and consistent performance of their equipment. Developed by Mitsubishi Electric, this innovative technology is ideal for protecting remote and hard-to-service equipment from moisture damage.

In summary, Rosahl micro dehumidifiers offer a dependable, efficient, and cost-effective solution for controlling moisture in cabinets and enclosures. Their solid-state design, compact size, and zero maintenance requirements make them an excellent choice for a wide range of applications. By choosing Rosahl, you can ensure the longevity and reliability of your equipment while mitigating the risks and financial consequences associated with excess moisture.

At Westside International Ltd we have over twelve years' experience in the application and selection of Rosahl solid-state enclosure dehumidifiers across many sectors. Please contact us for assistance at enquiries@westside-int.com

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